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order p^n . Let h_{i_1}, h_{i_2}, \dots represent the subgroups of H , of order p , and $J_{ik} = \begin{pmatrix} P_1 & P_2 & \dots & P_n \\ h_{i_1} & h_{i_2} & \dots & h_{i_n} \end{pmatrix}$ the isomorphism of H gotten by replacing P_j by any operation (order p) in h_{i_j} ($j=1, 2, \dots, m$), say the new generators from the k th set of all of the possible sets which might be chosen from $h_{i_1}, h_{i_2}, \dots, h_{i_n}$. The number of values of k is obviously equal to $\Phi(p)^n = (p-1)^n$. To determine the number of choices of *this set* of subgroups (number of values of i) suppose that a of a set of n generators have been selected. The remaining $n-a$ operations must be selected outside the subgroup H_{p^a} generated by the first a , and thus there remain

$$\frac{p^n - 1}{p - 1} - \frac{p^a - 1}{p - 1} = \frac{p^a (p^{n-a} - 1)}{p - 1}$$

subgroups h_{i_j} from which to select the remaining $n-a$. Thus the product of the number of values of k and the number of values of i is

$$h = (p-1)^n \prod_{a=0}^{n-1} \frac{p^a (p^{n-a} - 1)}{p - 1} = (p^n - 1)(p^n - p)(p^n - p^2) \dots (p^n - p^{n-1})$$

which is the number of choices of new generators of H , or the order of its automorph.

MECHANICS.

186. Proposed by R. D. CARMICHAEL, Hartselle, Alabama.

A point P keeps at uniform distance from and moves with uniform angular velocity around a point Q which is in harmonic motion, making one revolution while Q swings to and fro. If P is in the line of the path of Q and on the same side of the center of that path with Q when Q is at the extremity of the path, what is the locus of P ?

Solution by the PROPOSER.

Take the origin at the center of the path of Q , and let a = half the length of that path. Let $PQ = b$, and let θ = the angle of PQ with the path of Q at any time. Then, it is easily shown that $x = (a + b)\cos\theta$, $y = b\sin\theta$, the equations of an ellipse whose axes are $a + b$ and b .

Also solved by G. W. Greenwood, and G. B. M. Zerr.